With the author's
kind regards

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ROYAL COLLEGE OF SURGEONS OF ENGLAND

OBSERVATIONS ON THE FUNCTION OF THE PROSTATE GLAND IN MAN AND THE LOWER ANIMALS. Part II.

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In a former paper, entitled "Observations on the Anatomy of the Prostate," which appeared in this *Journal*, April 1889, I drew attention to the development of this gland, especially during the period of life from birth to adolescence, and pointed out the manner in which the lateral lobes of the gland during that time came to encircle completely, or almost completely, the first part of the urethra. I further indicated the close relation that exists between the glandular and the muscular structures, and the part played by the latter in expelling the accumulated secretion of the gland tubules into the urethra. In the present paper I wish to bring forward certain facts, chiefly anatomical, which will afford further evidences in support of the view I have put forward regarding the nature and function of the prostate gland in Man and in the lower animals.

These facts have been derived mainly from observations on the prostate in the lower animals, because in many of them the generative function is in abeyance for the greater part of the year, and consequently the glands concerned are *inactive*, while for a time, which varies in each kind, the generative function again becomes *active*. In such animals an opportunity is afforded to examine and trace the changes in these glands from their *inactive* or *quiescent* state to that of *activity*. This I have done in the Mole and Hedgehog, both of which show changes of a very marked degree in the generative apparatus at each *rutting* season.

I propose to give also the results of an inquiry into the changes which the prostate undergoes after complete castration, by which I mean removal of both testicles, in the domesticated animals and in Man; and then to make a general summary of the facts thus elicited.

I have examined the prostates of the Mole and Hedgehog at

stated intervals, namely, the middle of each month from October to May. But as it is quite unnecessary to describe each specimen, I have selected two extremes and an intermediate state. These extremes correspond to the *active* and *inactive* states of the sexual function respectively.

John Hunter was, I believe, the first to draw attention to the periodical changes in the sexual glands of birds and some mammals; and it is to these changes, especially as they affect the prostate gland in the examples above mentioned, that I wish to allude.

In the *Works of John Hunter*, edited by J. F. Palmer (vol. iv. p. 29), is the following observation:—"In the Mole the prostate gland in winter is hardly discernible, but in the spring becomes very large and filled with mucus." This was confirmed by Owen (*Comp. Anat.*, vol. iii. p. 656), who adds "that the prostate gland in the Mole begins to increase in February, and acquires an enormous size, and conceals the urinary bladder towards the end of March." Owen further observed that similar changes occurred in the prostate and other accessory sexual glands of the Hedgehog.

I have examined the generative organs of the Mole and Hedgehog, in and out of the rutting season, and found the above observations to be correct. All I have to add are the histological changes at the different periods.

During the winter months the testis and all the accessory sexual glands are small, and are in what may be called a *state of rest* or of *quiescence;* but during the spring or summer months they are many times larger, and are then in a state of functional *activity;* I would therefore, for convenience in description, call the former the *quiescent* state, and the latter the *active* state of the gland.

The Prostate in the Mole.

Quiescent State.

A full-grown male was killed on the 15th of November 1888, and the generative organs removed and placed in strong spirit. The prostate gland formed a small unpaired whitish mass of uniform consistency, about a line and a half across, which was situated on the anterior or ventral aspect of the first portion of

the urethra, immediately in front of the neck of the urinary bladder (see Plate II. figs. 1, 2, 3).

Under the microscope this is seen to be composed of a great number of distinct tubules, which are bound together by delicate, loose, connective tissue, supporting the blood-vessels and nerves. Each tubule is made up of two coats, an *inner*, which bears the glandular epithelium, and an *outer*, which forms a complete and continuous sheath. The *inner* consists of delicate connective-tissue, lined by a single layer of small cubical epithelial cells, which consist of clear protoplasm, and contain a large round granular nucleus. In some of the tubules this coat is thrown into slight longitudinal folds. The *outer* coat, forming a sheath to the tubule, is made up of a thick layer of long spindle-shaped cells, similar in all respects to connective-tissue cells, arranged concentrically round each tubule (see Plate III. fig. 7). Such is the histology of the prostate during the early winter, and not until February is there any change visible either to the naked eye or under the microscope. I shall, therefore, dismiss at once the state of the prostate during December and January, and proceed to describe its state in the month of February.

Intermediate Stage.

A full-grown male was killed on the 15th of February 1889, and the organs were removed and prepared as in the former case. The prostate was about three times as large as that in the month of January, and there were slight evidences of the enlargement of each tubule (see Plate III. fig. 8).

Under the microscope the same structures are seen as in state I., but the tubules had grown and are much larger and more closely packed together. In the *inner* coat the longitudinal folds, seen only in a few examples in the quiescent state, are very marked, and into each fold a fine process of connective-tissue extends from the outer or non-epithelial part of this coat. Some of these folds show a subdivision into two lesser folds near their free ends. The epithelial lining is no longer composed of the cubical but of columnar-shaped cells, and between their tapering attached ends there are numerous small round cells. In only a few of the tubules a small amount of mucus

had formed and filled the lumen. The *outer* coat consists, not of cells identical with connective-tissue cells, but of well-developed granular non-striped muscle cells, forming a thick layer. These muscle cells contain rod-shaped nuclei, and take on the characteristic yellowish-brown stain with picrocarmine (see Plate III. fig. 8).

Active Stage.

A full-grown male, killed on the 15th of March 1889. The prostate gland now formed a mass many times the size of that in the quiescent state, and measured nearly $\frac{3}{4}$ of an inch across. It was visibly composed of a number of small tortuous tubules, which were united together by a small amount of delicate connective-tissue. From the front the enlarged, now active, prostate quite concealed the urinary bladder (see Plate III. fig. 9).

Under the microscope the chief alterations are to be found in the tubules. These had grown during the last month or six weeks to many times their original size, and the inner coat had become gradually more and more complicated. The longitudinal folds which were just beginning to divide in the intermediate state, had gone on dividing and subdividing until each had produced a kind of filamentous tree, projecting free into the lumen of the tubule. In this way the extent of surface covered by epithelium had been enormously increased, and the epithelium now constituted a single layer of tall columnar epithelial cells, with finely granular protoplasm, and a round nucleus near the attached end. Between the attached ends of adjacent cells there are small round granular cells, which in all probability replaces the columnar ones whenever they became exhausted and cast off. The *outer* coat consists of perfectly developed, non-striped, muscle cells. This formed a thick, strong, muscular coat capable of expelling the accumulated secretion of the gland-tubules (see Plate III. fig. 9).

The central lumen of each tubule was occupied by a coagulum (resulting from the action of the spirits) mainly composed of a more or less homogeneous substance like *mucin*, and a great many small round cells resembling leucocytes.

The Hedgehog.

Quiescent Stage.

A full-grown male was killed in the middle of December 1888. The generative organs were removed and prepared as those of the Mole. The prostate gland formed a small bilobed mass on the ventral aspect of the beginning of the urethra, just in front of the neck of the bladder (see figs. 4, 5, 6).

Under the microscope each lobe was seen to consist of a number of distinct tubules, separated from one another and bound together into one mass by a considerable amount of loose fibrillar connective-tissue. Each tubule is composed of two coats, one *inner* and one *outer*. The *inner*, like that in the Mole, is formed of connective-tissue lined by a layer of low cubical epithelium; and the *outer* of a thick layer of concentrically arranged long spindle cells, which, in this animal, as well as in the Mole, are destined to develop into non-striped musele-cells.

Intermediate Stage.

All I need say in regard to this stage is that it corresponds in every detail to the same stage in the Mole (see Plate III. fig. 8).

Active Stage.

A full-grown male was killed in July 1888. The prostate glands formed two large masses made up of tortuous tubules placed in front of the urinary bladder (see Plate II. fig. 6).

Under the microscope the same elements are seen as in the quiescent stage of the gland, but the tubules had grown and become many times larger than in that stage. The *inner* coat had to a slight degree developed longitudinal folds, and is lined by a single layer of deep columnar-shaped cells, with finely granular protoplasm, and round nuclei near their attached ends. Between their attached ends were a number of small round cells, which, as I have stated, in the case of the Mole, in all probability replace the exhausted and cast-off columnar cells. The outer coat is now composed entirely of a layer of well-formed non-striped muscle-cells. Each tubule is filled, as

in the Mole, with a mass of coagulated mucus, which contains a number of small, rounded bodies, staining deeply with carmine (see Plate III. fig. 11).

Note.—Cowper's glands undergo precisely the same changes as the prostate, both in the Mole and Hedgehog. In the latter animal the secretion from this gland during the summer is abundant, and possesses a peculiarly disagreeable and penetrating scent-like odour.

The Effects of Castration upon the Prostate Gland.

The general effects of castration, corporal as well as mental, do not concern my purpose in this paper, and I shall therefore only refer to the effects of castration upon the Prostate and Cowperian glands. The behaviour of these accessory sexual glands after the removal of the testes will, I think, enable us to decide whether, on the one hand, they are developed in relation to the generative function, and entirely owe their existence to the generative stimulus, or, on the other hand, whether they arise independently of the testes and are essentially developed in functional relation to the urethral channel, and serve to produce a secretion which has for its purpose the moistening of that channel.

The operation of castration in various animals has been practised for many centuries, yet, so far as I have been able to ascertain, the first description of the associated changes in the generative apparatus was given by John Hunter. The following is an extract from Hunter's *Works* (vol. iv. p. 30):—

"The prostate and Cowper's glands, and those of the urethra in the perfect male [Bull], are soft and bulky, and the secretion is salt to the taste.

"In the castrated animal [Bullock] these are small, flabby, tough, and ligamentous, and have little secretion. Especially marked is the change when the animal is castrated when young."

I have been able to confirm Hunter's observations on the generative apparatus of the Bullock, and have extended this inquiry to other domesticated animals, especially the Dog and Cat, and have also studied the histological changes which gradually supervene in the prostate after castration.

For the purposes of illustrating this subject I shall here describe a few instances in the case of the Dog and Cat and give the histological changes observed.

In the Dog.

Case I.—A mongrel dog, aged three years, was castrated when two years old. Therefore the changes from a normal state, which in the Dog is much the same as in Man, induced in the structure of the prostate, to be immediately described, were developed in the course of one year.

The prostate was found to be small, firm, tough, and fibrous, and it presented a great contrast to the large, soft, and glandular organ in the full male Dog.

On section, a few irregular streaks of gland tubules were seen, and these were well separated from one another, and embedded in a dense fibrous stroma. The stroma seemed almost devoid of any muscular tissue.

Microscopically, the remains of the gland tubules, as seen by the naked eye, form isolated and slightly branched columns or fissures, supported and separated by a relatively large amount of stroma which consists mainly of old fibrous connective-tissue. Some of these fissures, which represent the prostate tubules, are lined by a single layer of epithelial cells, which are small, flattened, and of irregular shape, whilst others are filled by epithelial cells of much the same appearance.

The protoplasm of these epithelial cells is small in amount and clear; and it is indeed but little if at all differentiated into that kind of protoplasm which is regarded as typical of glandular and functional epithelium. This retrogression, as I venture to call it, of the normal prostatic glandular epithelium into a lower and practically functionless type is very marked, and reminds me of similar retrogressive changes in the epithelial cells of other glands under various diseased conditions—for example, in the kidney and liver.

The stroma is composed in parts of fibrous connective-tissue containing a few connective-tissue cells; and in other parts there are in addition to the connective-tissue cells some muscle fibres, which are less numerous than in the normal gland, and these are found in various stages of atrophy. The stroma forms, therefore, the main characteristic constituent in what represents the prostate after castration, whereas in the normal gland of the entire male the glandular constituent and unstriped muscular fibres form the most marked and characteristic structure (see Plate III. fig. 12).

Case II.—A full-grown, castrated Spaniel Dog. The time at which castration was performed is unknown.

The *prostate* was found to be of small size—I judged it to be about one-third the normal size in a similar kind of dog—firm, and hard. On section it was very like fibrous tissue in which were scattered a few remnants of glandular structure. This so closely resembled the prostate of the preceding case that its description applies equally well.

Under the microscope the gland tubules are represented by slightly branching tubules which are in parts lined by a very low cubical, and in other parts by flattened, clear, epithelial cells. The epithelial cells and the stroma present the same general characters as those described in Case I.

I have been able to obtain several other examples of castrated dogs, but as they show nothing more than is above described, I need not occupy space in repeating the description.

In the Cat.

Case III.—A five-year-old Cat, which was castrated when about three weeks old.

In the position of the *prostate* was found a small, firm, bi-lobed and unsymmetrical mass, about one-fourth the size of the normal prostate in entire male cats. A section of the mass revealed that in one-half (the largest) there still existed a small amount of gland-like tissue towards the centre. In the opposite half no glandular tissue could be detected by the naked eye. *Cowper's glands* were small, tough, and fibrous.

Under the microscope the lobule, which was observed to be devoid of any glandular structure, is found to entirely consist of old fibrous connective-tissue without any traces of prostatic gland tubules; but in the other half there is a remnant of an almost perfectly formed part of the gland, more or less occupying the centre. The tubules in this, however, have a simpler arrangement than obtain in the normal gland, and they are separated from one another by a considerable amount of connective-tissue, in which there are a few well-formed non-striped muscle-cells arranged around the extremities of the gland-tubules. The epithelial cells lining the tubules are columnar in shape, and resemble very closely those found lining the tubules of the normal prostate gland.

Cowper's Glands.—Small and fibrous. See Case IV. for description.

Case IV.—A full-grown Cat, of unknown age, which was in all probability castrated when a few weeks old, according to the not uncommon practice.

The prostate was represented by a very small, firm, and fibrous mass. No trace of gland structure could be detected with the naked eye, on section through it. *Cowper's glands* were in a similar state, *i.e.*, small, firm, and fibrous.

Microscopically, the remains of the prostate consist of a mass of fibrous connective-tissue containing very few muscle-cells, which are in various stages of atrophy. Embedded in this dense stroma there are small columns of degenerated epithelial cells, which once formed the glandular epithelium of the tubules.

In Cowper's glands the same appearances are seen; but the disappearance of the glandular structure has not advanced to such a degree as in the prostate. The tubules are slightly branched, and are in some places lined by small cubical epithelial cells, but in others

are filled with small irregular cells, forming columns similar to those seen in the prostate. The stroma of the gland is relatively very much increased, and is formed of fibrous connective-tissue.

I have also examined the generative organs of the Pig, Bullock, Sheep, and Horse after castration, and found that in each case like changes supervene.

In Man.

Although opportunities for examining the generative organs of castrated men occur not unfrequently, yet there are but few cases on record, and these cases, chiefly by German authors, have been investigated rather with respect to the general changes in the whole frame, and the degree of approach to that of the female, than to the special changes in the sexual apparatus.

Although I have not had an opportunity of examining the state of the prostate in eunuchs, yet I think it will be of interest to make here a few quotations from the reports of others.

Professor Gruber,[1] in a description of the case of a man castrated in early youth, who died at the age of sixty-five years, speaks of the prostate and utriculus masculinus in the following terms:—

"Diese [Prostata] ist sehr verkleinert. Bei angebrachten Drucke konnte ich den Liquor prostaticus an den Mündungen ihrer Ausführungs-gänge hervorquellen sehen.

"Die Vesica prostatica s. Utriculus prostaticus, s. virilis, s. Uterus masculinus nach Weber ist unverhältnissmässig vergrössert, so zwar, dass das hintere Ende derselben von einige Linien den hinteren Umfang der Prostata überragte."

Dr Bilharz, in a thesis entitled *Descriptio Anatomicæ Organorum Genitalium Eunuchi Æthiopis*, Berl. 1859, gives the result of the examination of two castrated men, and he confirmed the observations made by Professor Gruber.

Pelican, in a book (*Skopzenthum in Russland*, 1876, s. 99) devoted to the study of this peculiar sect in Russia, mentions that the prostates in eunuchs are about the size of that found in the child.

The above are the only observations that I have been able to

[1] Müller's *Archiv*, 1847, s. 469.

find; but these, I think, are sufficient to show that after castration the prostate in Man undergoes similar changes to those above described in the Dog. The fact that some so-called liq. prostaticus was expressed by Professor Gruber out of the remaining tubules of the prostate can be well explained by the presence of a certain amount of watery and clear fluid, not necessarily liq. prostaticus, persisting in the remnants of the ducts and tubules which remain for a considerable period, and probably never entirely disappear.

Arrest of Growth of Testes, and its Effects upon that of the Prostate in Man.

I have on more than one occasion noted the small size of the prostate gland in Dogs, when the testes were also smaller than usual; but I wish here to relate an instance of arrest of growth of the prostate in a case of arrest of growth of the genital organs. During the winter of 1888–89, Mr Willett kindly gave me an opportunity of examining a patient then under his care at St Bartholomew's Hospital, in whom the testes and external genitals had become arrested in their growth before puberty, and through the kindness of Mr Bowlby I am able to give the notes of the case.

A young married man, thirty-three years of age, suffering from *delirium tremens*. He was of medium height, flabby, beardless, and had a high-pitched voice such as is observed in eunuchs. The external genital organs, including the penis, scrotum, and testes, were only developed to the size of those of a boy between six and seven years old, and the pubes were covered by fine downy hair. On examining *per rectum* nothing more than a firmish transverse ridge could be felt in the position of the prostate gland. Micturition was normal, except during his illness, when he suffered from retention.

Another case illustrating the effect of removal of the testes upon the growth of the prostate is given by Civialé in his work[1] on diseases of the genito-urinary organs:—"Il s'est présenté, dans un hôpital de Paris, un calculeux auquel on avait pratiqué la castration de l'un et l'autre côté, pour le guérir de deux hernies. Lorsqu'on le tailla, ou reconnut que la prostate

[1] *Traité Pratique sur les Maladies des Organs genito-urinaires*, tom. ii. p. 338.

n'existait pour ainsi dire plus. On pensa que l'enlèvement des testicules avait exereé iei quelque influence."

General Summary.

It is well known that in wild animals the sexual activity recurs with a certain regularity every spring, and quiekly acquires its full powers. After the acquirement of full sexual power the activity remains at its height for a time that is variable in duration in birds and some mammals; and then it gradually declines until its entire disappearance, and the sexual function is onee more in abeyance compared with the nutritional and other functions of the body. This cyclical recurrence in the sexual activity or periodicity, as it may be called, is very marked in the examples of the Insectivora that I have chosen. It is accompanied by well-marked anatomical changes, which ean be observed not only in the testes but also in the accessory generative glands, such as the prostate, vesiculæ seminales, and Cowper's glands, and throughout the whole of the generative apparatus. These changes are preceded by an increased vascularity of the whole tract, which determines an increased growth of all the glands and parts concerned in generation.

In the testicle the quiescent seminiferous tubules enlarge, and their lining epithelium proliferates and grows, in order to form cells, which give origin by special division of their nuclei to spermatozoa; this eonstitutes a return to sexual aetivity. In the prostate the quieseent tubules and their lining of epithelium undergo similar changes, with the exception that the epithelial eells thus formed develop into typical glandular or seereting cells, which secrete a fluid containing a large amount of mucin.

The period of sexual activity is the same in both glands, and they are dependent, or rather controlled, by the sexual stimulus, whatever the nature and course of that may be. At the end of the sexual season these glands begin to decline in activity, and then they diminish until they return to the quiescent state in which they remain for the rest of the year.

As has been shown above, the prostate in this quiescent state is composed of a few tubules lined by flattened and small epithelial cells, which are undoubtedly functionless as regards

the production of any secretion, but they possess the power of reproducing glandular epithelial cells when the appropriate time recurs. Therefore there can, I think, be no doubt that the prostate in these examples of the Insectivora, and, if in them, probably in all the mammals from the Marsupials upwards, is purely a sexual accessory gland, which produces a secretion whose sole purpose is to be incorporated with the testicular secretion and then ejected as an integral part of the seminal fluid.

Seeing, then, that the prostate is an accessory sexual gland, and acts in concert with the testes, it now remains to inquire into the manner in which the prostatic secretion, which is constantly formed during the period of activity in the rutting animals, is retained, and also by what mechanism the retained secretion is expressed into the urethra during the sexual act.

In corroboration of the view that the prostatic secretion is being constantly formed during the period of activity of the gland, is the fact that the tubules are always filled to a certain degree with secretion which coagulates by treating with alcohol, and also that the epithelial cells lining the tubules show numerous *muciginous* granules, especially in the inner or lumen half, but also, though less markedly, in the outer half of each cell.

The secretion is retained in the tubules where it is being formed, but especially is it retained in those parts of the tubules nearest to the urethra, which are usually larger. Therefore, there exists in this gland the simplest, and at the same time the most primitive, means for retaining its secretion until a demand for its expulsion into the urethra arises. The secretion thus accumulated is expelled into the urethra during the sexual act by means of the contraction which begins at the distal end of the tube, of the complete and continuous sheath of non-striped muscle that surrounds each tubule in its whole length. This sheath of muscle may be well seen in fig. 11.

The secretion is thus expelled into the prostatic—the most capacious—part of the urethra, where it mixes with the secretion from the testes and the other accessory sexual glands, before the seminal fluid proper is ejected through the urethra.

The prostate gland differs in its mode of retaining and

expelling its secretion from most other glands in the body, and it seems to me that such a muscular mechanism is made in the prostate for expelling its secretion as quickly as possible into the prostatic urethra, inasmuch as there exists no common reservoir in which the various components of the seminal fluid can be stored in a state ready for use. The existence of such a large amount of non-striped muscle in the prostate of these animals is a striking feature, and at once recalls the structure of the prostate in the higher mammals and in Man.

In my paper "On some Observations on the Anatomy of the Prostate" (*Jour. of Anat. and Phys.*, vol. xxiii. p. 374) I ventured to regard the intrinsic muscle fibres of the prostate as subservient in function to the glandular tubules, and endeavoured to show that in the developing prostate the muscle could be seen running in fine bundles in close relation to the tubules, and in such a manner as to be capable of exerting compression upon them. In the Mole there exists the simplest possible arrangement; but in Man, and indeed the Dog and Cat, the tubules have become more branched and more complex, and with this progressive evolution the muscle has been spread out on the various branches of the tubules, and has apparently lost its more intimate relation to them.

Again, after castration in the animals before mentioned (Dog, Cat, &c.), and in Man, the prostate, after the lapse of a year or more, becomes transformed into a mass of fibrous connective-tissue, which contains the remains of the once active gland-tubules, and a small number of atrophied muscle-fibres scattered here and there. The complicated and much branched prostatic tubules, together with the non-striped muscle which forms a pronounced constituent of the normal prostate, have disappeared almost entirely, leaving however some remnants both of the gland tubules lined by epithelium, which has lost its glandular or secretory function, and of the non-striped muscle-fibres.

This is the case in Dogs, Cats, Pigs, Bullocks, Horses, and in Man. Further, it has been shown above that the growth of the prostate is dependent upon the growth of the testes, and in its history follows exactly the same course as that organ; for instance, the prostate, as well as the testes, remains of small size until the time of puberty, when the generative apparatus

acquires its full development, and both glands rapidly enlarge and attain their full size. Further, in the example of arrest of growth of the testes which I have given, associated with a similar state of the whole generative apparatus, it has been pointed out that the prostate remained in a state of rudimentary development, thus corresponding with the genital glands and apparatus.

EXPLANATION OF PLATES II., III.

Figs. 1, 2, and 3, Pl. II. × $\frac{2}{3}$.—Views from the front of the generative organs of the Mole (*Talpa europ.*), which were removed (1) in the middle of December, (2) in the middle of February, and (3) in the middle of March. These show the gradual development of the generative glands from the *resting* to the *active* stage. *a*, prostate gland; *b*, testes; *c*, urinary bladder; *d*, penis; *e*, rectum; *f*, membranous part of urethra covered by the well-developed *constrictor urethra*.

Figs. 4, 5, and 6, × $\frac{2}{3}$.—Similar views of the generative organs of the Hedgehog (*Erinaceus europ.*)—(4) in the middle of winter, (5) in April, and (6) in the summer. The letters indicate the same structures as in figs. 1, 2, and 3. *g*, kidneys; *h*, seminal vesicles.

Fig. 7, Pl. III. × 80.—Transverse sections of two tubules from the prostate gland of the Mole in the *resting* stage, showing the small size of the tubules, which are lined by (*a*) very low cubical epithelium, and surrounded by (*b*) a thick layer of large spindle-shaped cells, representing the muscular sheath.

Fig. 8, × 80.—Transverse sections of two tubules from the prostate gland of the Mole in the *intermediate* stage, showing a considerable increase in the size of the tubules. The lining is now convoluted, and is covered internally by low columnar epithelial cells (*a*), and externally by a well-developed ring of non-striped muscles (*b*).

Fig. 9, × 80.—Transverse section of a tubule of the prostate gland of the Mole in the stage of *activity*, showing an enormous increase in size of the tubule; the subdivision of the folds covered by columnar epithelium, and the coagulated secretion, containing many small round cells, in the lumen. The muscle forms a well-marked ring around the tubule. *a*, columnar epithelium; *b*, ring of non-striped muscle; *c*, coagulated secretion.

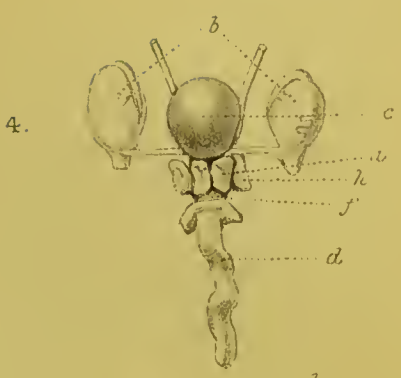
Fig. 10, × 80.—(A) Transverse section of a tubule of the prostate gland of the Hedgehog during the *resting* stage, showing precisely the same structures as are seen in fig. 7. (B) Longitudinal section of a tubule from the same prostate, showing the way in which they branch and also the continuous sheath of non-striped muscle fibres.

Fig. 11, × 80.—Transverse section of the tubules of the prostate gland of the Hedgehog during the *active* stage, showing the great

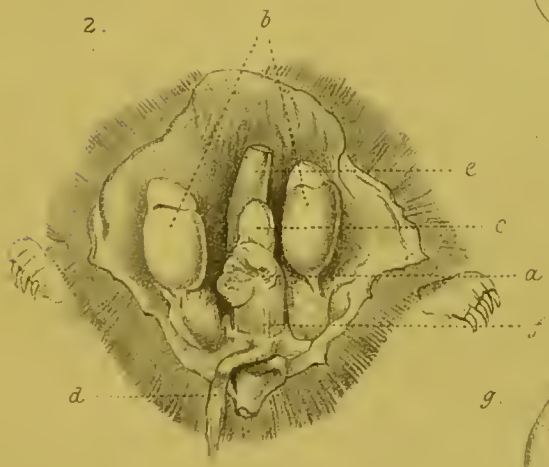
increase in the size of each tubule. The convoluted lining is covered by well-developed columnar epithelium. The lumen is partially filled with coagulated secretion. Each tubule is surrounded by a well-marked ring of non-striped muscle-fibres. *a*, epithelium; *b*, muscle-ring; *c*, loose intertubular connective-tissue.

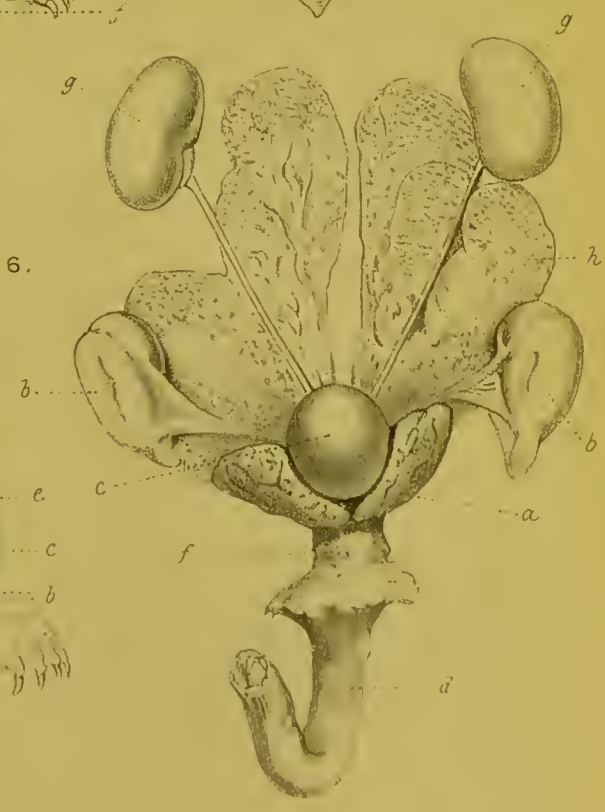
Fig. 12, × 80.—A section taken from the periphery of the prostate gland of a Spaniel Dog which had been castrated (see Case II.). It shows that the gland has been almost entirely converted into fibrous connective-tissue, in which there are seen a few branching fissures lined by flattened epithelium. These represent the original gland tubules; and there are only traces of atrophied muscle-fibres. *a*, altered gland tubules; *b*, connective-tissue stroma.

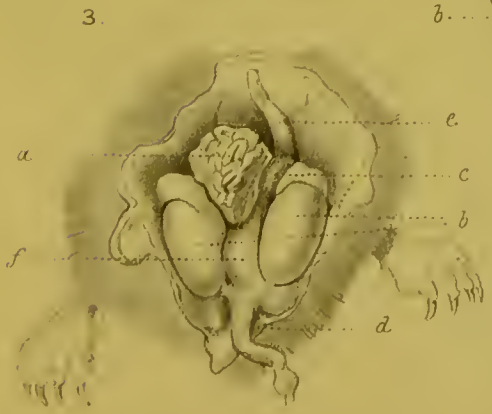












PROSTATE GLAND.

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